Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan

Ephrata Landfill Corrective Action

Prepared for

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and

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1 INTRODUCTION

This document summarizes work to be performed during a groundwater Remedial Investigation and Feasibility Study (RI/FS) at the Ephrata Landfill (Site) in Grant County, Washington. The RI/FS work plan is in addition to work that will be performed under the Interim Remedial Action Plan (IRAP), which is summarized in this work plan, and submitted at this time under separate cover. Work will be performed by Parametrix, Inc. and Pacific Groundwater Group under a Professional Services Agreement with Grant County (County) and the City of Ephrata (City) (the Potentially Liable Parties or PLPs) or their legal representatives. The RI/FS will be conducted to select remedial measures to address contamination at the Site and to select a final remedy for cleanup in compliance with the requirements of the Model Toxics Control Act, Chapter 70.105D RCW, and its implementing regulations, Chapter 173-340 WAC.

2 SITE LOCATION, OWNERSHIP, AND OPERATION

The Site is located about three miles south of the City of Ephrata on the east side of Highway 28 in the western portion of Section 33, Township 21 North, Range 26 East, Willamette Meridian (**Figure 1**). The City of Ephrata began operating the landfill in approximately 1942 and owned and operated it until 1974. The City owned part of the property set aside for the landfill and leased additional property from the United States Bureau of Reclamation. In 1974, the City and the County entered into the first of a series of agreements under which the County leased the landfill and operated the facility. In 1990, the Bureau of Reclamation transferred its landfill property to the County. In 1994, the City deeded its landfill property to the County. A new landfill on the site remains the primary solid waste disposal facility for Grant County.

Filling began in the northwest portion of the original landfill and expanded south and east as an unlined landfill until a new lined landfill was opened in 2004 (**Figure 1**). Burning was allowable in the early open dump, but practices were not documented. Unintentional fires have occurred more recently in the original landfill. The new landfill is physically separated from and located to the south of the old landfill. The old landfill was permitted by Grant County Health District first under Chapter 173-304 Washington Administrative Code (WAC) and then under Chapter 173-351 WAC. The new landfill is permitted under Chapter 173-351 WAC. Current solid-waste-related facilities at the site consist of the old landfill, which is no longer receiving waste and which is being prepared for closure, the new lined landfill, recycling facilities, leachate evaporation pond, a machine shop and office, a truck scale, electric power, a deep water supply well, two lysimeters, and numerous landfill gas and groundwater monitoring wells. The County has recently acquired additional land parcels and is planning changes to site access for the new landfill (**Figure 1**).

3 OBJECTIVES OF THE RI/FS

The County and City (Potentially Liable Parties - PLPs) are performing this RI/FS to evaluate site cleanup requirements under applicable regulations. The RI/FS will comply with cleanup requirements administered by the Department of Ecology (Ecology) under Model Toxics Control Act, Chapter 173-340 WAC regulations. MTCA is used by the State to enforce and guide cleanup of solid waste facilities undergoing corrective action as defined in Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC). The RI/FS will be used to define the remedial measures required to clean up the site under these regulations.

The RI/FS is being performed under an Agreed Order with Ecology. Upon completion of the RI/FS, the PLPs will evaluate the administrative options for implementing any necessary remedial actions.

This document provides an overview of tasks to investigate the site and evaluate remedial options. Investigation tasks are described in Sections 5 and 6 and remedial option evaluations are described in Section 7. These general task descriptions will be supplemented by a Sampling and Analysis Plan, Quality Assurance Plan, and Health and Safety Plan, to be provided prior to field work.

4 BASIS AND RATIONALE FOR RI/FS SCOPE

This section provides an overview of previous investigative findings at the Site, an evaluation of MTCA clean up requirements, and the rationale on which the scope of work for the RI/FS is based.

4.1 PREVIOUS FINDINGS

The following sections provide an overview of past environmental investigative work conducted at the site, a summary of the site conceptual model, and site hydrogeology.

4.1.1 Overview of Prior Environmental Investigations and Events

The following list summarizes the modern environmental events and investigations at the site.

1937: Land Classification Map by U.S. Bureau of Reclamation defines pre-waste soil conditions and topography.
1942: Landfilling begins.

1950's: 30 ft increase in water table elevation in response to importation of irrigation water by the federal Columbia Basin Irrigation Project. State of Washington publishes Water Supply Bulletin No. 8 (Walters and Grolier, 1960).
1975: Disposal of approximately 2000 drums of industrial waste.
1984: Ecology submitted a Preliminary Assessment to the EPA and recommended a follow-up Site Investigation.
1987: The EPA conducted a preliminary Site Investigation and intended no follow-up investigation.
1987: Ecology completed a Phase I Site Inspection Report stating that further actions should be based on near-future groundwater monitoring to be developed by the County.
1989: Groundwater and landfill gas monitoring began at the Site.
1990: Black and Veatch Inc. and Pacific Groundwater Group publish the first Hydrogeologic Assessment Report which documents anomalous groundwater quality (B&V and PGG, 1990a). Numerous groundwater monitoring reports were submitted to Grant County Health District and Ecology starting at this time.
1990: Black and Veatch Inc. and Pacific Groundwater Group publish a Phase 2 investigation report on the "Roza Aquifer" which delineates and describes contamination in that aquifer (B&V and PGG, 1990b).
1993: Decommissioning and replacement of old water supply well (which was contaminated).
2000: Corrective Action proposed by County in letter to Ecology.
2000 – 2002: Pacific Groundwater Group installs numerous additional monitoring wells and two extraction wells, and performs testing of the Roza aquifer.
2004: The new landfill opens and waste is no longer placed in the old unlined landfill.

4.1.2 Summary of Site Conceptual Model

Based on the investigations cited above, a site conceptual model has been developed and is described in this subsection. Subsequent subsections provide greater detail on the hydrogeologic conditions upon which the conceptual model is based. The existing data are used to focus the efforts of this RI/FS by developing a preliminary site conceptual model; identifying existing data gaps; developing a preliminary list of contaminants of concern (COC); and identifying a preliminary point of compliance (POC).

Waste disposal began in the northwest corner of the northern-most 40-acre parcel and proceeded first toward the east, and then south. Waste was initially deposited within both natural depressions and trenches excavated within the outwash soils above basalt. Burning of waste in areas of early disposal was reportedly allowed to reduce volume prior to covering. Unintentional fires have also occurred and these were sometimes controlled with application of water. Hazardous wastes were typically included in landfill refuse disposed prior to 1981 when Resource Conservation and Recovery Act requirements changed that practice[1]. In the case of Ephrata landfill, we distinguish possible incidental hazardous waste from the drums of industrial waste known to have been stacked and covered. At this site, the County ceased intentional disposal of industrial waste in 1975.

The water table rose about 30 feet in the early 1950s in response to leakage of water from irrigation works of the Columbia Basin Irrigation Project (Walters and Grolier, 1960). The water table rose to saturate the lowest few feet of refuse over a limited area at the north end of the old landfill.

Some time prior to 1983[2], a basalt aquifer – now called the Roza aquifer – and limited areas of groundwater within saturated outwash became contaminated with inorganic and organic contaminants as a result of leaching of refuse and possible migration of liquid wastes into the aquifer. These contaminated water bodies are not naturally well connected to other aquifers. Nonetheless, contaminants from this aquifer on the north end of the old landfill migrated slowly with groundwater, primarily downward and to the south, with limited migration now documented to the west. One probable route of downward migration was the old water supply well on the west edge of the old landfill (**Figure 2**) which penetrated the Roza aquifer and lower basalt aquifers with an open borehole until May 1986. Some contaminants degraded naturally along the flow paths and all contaminants were diluted by the large volumes of groundwater found in the larger downgradient aquifers – now called the Interflow aquifer and Outwash aquifer (**Figure 3**).

Other contaminant migration pathways to groundwater may be, or may have been, active. Landfill gas is generated by decomposing refuse. The gas contains low concentrations of volatile organic contaminants that evaporate from the refuse. The contaminants can diffuse or advect with the migrating landfill gas (which is largely methane and carbon dioxide). Subsequent diffusion into the underlying groundwater can result in groundwater contamination.

Another potential pathway of contaminant migration is leachate derived directly from newer refuse. Low volumes of seasonal precipitation and possible moisture created from decomposition move downward through the waste. Large volumes of water have been sprayed onto the newer parts of the old landfill to control fires within the refuse. Downward migration of these waters and leaching of constituents within the refuse could result in groundwater contamination within the Interflow and Outwash aquifers. In addition, poplar trees have been fertilized and irrigated near the landfill. Leaching of

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[1] Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, EPA/540/P-91/001, OSWER Directive 9355.3-11, February 1991

[2] A groundwater sample from the old supply well was analyzed in 1983. The analyses suggest groundwater contamination existed at that time.

fertilizer constituents could appear to be landfill leachate. The Roza aquifer is not part of these potential contaminant pathways.

A plume of groundwater contamination is slowly expanding to the south with possible smaller components of flow to the east and west within the Interflow and Outwash aquifers. Downward migration to deeper basalt aquifers is also possible, but has been minor to date, except locally at the old supply well, which was pressure grouted and decommissioned in 1993. The mass of contaminants is dominated by common inorganic leachate constituents with lower concentrations of organic contaminants including fuel constituents and chlorinated solvents. Preliminary evidence suggests both physical and chemical/biological attenuation is occurring.

The Roza aquifer does not extend off-site in downgradient directions. The Interflow and Outwash aquifers do extend off-site with the Interflow aquifer used in downgradient areas for domestic water supply. However, development in the area is sparse and the closest well toward the south is more than 2500 feet from the old landfill. The Outwash aquifer (with its artificially high water table) is drained by irrigation wasteways but supports wetlands and other surface water features with possible ecological value. Although the Columbia River lies west of the site, the basin structure promotes groundwater flow ultimately toward Moses Lake, which is several miles southeast of the landfill.

4.1.3 Buried Drums and Geophysical Investigation

Two thousand drums reportedly containing industrial waste were reportedly stacked and covered at the north end of the landfill in 1975 (**Figure 2**). The wastes were reported as "solidified paint sludge, organics, inorganics, and solvents from manufacturing sources". A one-time deposition of un-rinsed pesticide containers is also reported. The location of the drums was verified by interviews with landfill personnel and a magnetic gradiometer survey conducted in September 1990 (B&V and PGG, 1990b). The magnetic survey was concentrated in an area surrounding the identified location. The results of the survey showed a series of strong magnetic anomalies outlining a NW-SE trending feature in the area identified by the landfill personnel. Interpretation of the magnetic survey suggests the main stack of drums is approximately 110-220 feet in length with a width of about 35 feet.

The geophysical survey was extended off-site, north of the landfill fence. No drums or conductive materials were indicated north of the landfill.

4.1.4 Site Hydrogeology

Current understanding of the hydrogeologic setting, groundwater flow paths, sources of contamination, and potentially impacted aquifers is based on surveyed boring logs and groundwater sampling data collected since monitoring of the landfill began in 1989.

The site lies within the Quincy basin of the Columbia Plateau physiographic province. The plateau is characterized by a thick sequence of fine-grained and dense basalt flows, collectively known as the Columbia River Basalt Group. The younger flows comprise the Yakima Basalt Subgroup, which is present in the Ephrata area and is divided into three formations (from youngest to oldest), Saddle Mountain, Wanapum, and Grande Ronde Basalts. The Wanapum Basalt crops out in the study area.

Sedimentary rocks interbedded with the basalt flows are collectively known as the Ellensburg Formation and consist of fluvial and lacustrine sediments and layers of volcanic ash. The Vantage Member crops out near Ephrata.

Unconsolidated sediments overlying the basalts in the Quincy basin include coarse gravels and sands deposited by glacial melt-water, alluvium, and loess. These deposits occur at or near land surface.

Three aquifers are currently monitored at the site: the Outwash aquifer, the Roza aquifer, and the Interflow aquifer (**Figure 3)**. The three aquifers were identified in the original hydrogeologic assessment as the upper-most aquifers below the landfill that could transmit contaminants from the landfill past the point of compliance established for solid waste monitoring purposes (B&V and PGG, 1990a and 1990b).

The Roza and Interflow aquifers occur in permeable weathered zones within the upper parts of the Wanapum Basalt. A weathered interflow zone between two basalt flows within the Roza Member of the Wanapum comprises the Roza aquifer, and the underlying weathered contact between the Roza Member and underlying Frenchman Springs Member comprises the Interflow aquifer. The Outwash aquifer occurs in the saturated sands and gravels that overlie the Wanapum Basalt.

Deeper basalt aquifers (greater than 300 ft below ground surface - bgs) occur within the Frenchman Springs Member of the Wanapum Basalt and within the even deeper Grand Ronde Basalt beneath the site, as indicated by deep water supply wells (decommissioned 33E1; Atkins New (32A2) and 33M1). The Frenchman Springs aquifer is defined as a water bearing zone in the lower portion of the Frenchman Springs Member screened by wells 33E1 and 32A2. Well 33M1 is screened in a water bearing zone within the Grand Ronde Basalt. Transport of contaminants to these deeper aquifers is possible through natural pathways, but sampling in well 32A2 and 33M1 indicates low concentrations of possible site contaminants. The anisotropic sequence of basalt aquifers and aquitards promotes horizontal contaminant migration and high dilution rates within deep aquifers. Historical vertical migration is likely through the old landfill supply well 33E1 which penetrated the Roza aquifer, Interflow aquifer, and deeper Frenchman Springs aquifer with an open borehole until May 1986. At that time the well seal was extended downward by cementing. Well 33E1 was pressure grouted and decommissioned in 1993 because of continued evidence of contamination. The deeper aquifers are not currently monitored at the site.

4.1.4.1 Basalt Surface

The surface of the Wanapum Basalt (**Figure 2**) is irregular and outcrops in the northern part of the site at an elevation of about 1260 ft. Two subsurface depressions about 10 to 20 feet deep occur in the basalt surface beneath the old landfill (**Figure 2**). The larger depression has been called "the Hole." The basalt surface slopes gradually towards the south-southeast to an elevation of about 1160 feet in the southeast corner of the site near the new landfill. The basalt surface also slopes west towards a buried north-south trending coulee (scour-channel) along Highway 28 to an elevation of about 1140 ft (or a depth of about 90 ft below ground surface). Just west of the landfill this coulee is filled with about 35 ft of silt/clay over gravel in the vicinity of MW-18a. The silt/clay was mined at the location of the "clay pit" just south MW-18a.

4.1.4.2 Groundwater in the Hole

Groundwater in the Hole at EW-1 occurs as an unconfined aquifer of limited lateral extent and is contaminated by leachate (see groundwater quality data below). The aquifer occurs in a sediment-refuse mix in the bottom of the Hole. The aquifer is bounded by low-permeability basalt, which forms the underlying and lateral margins of the Hole. The bottom elevation of the aquifer occurs at about 1227 ft (bottom of the depression) and the top is defined by the water table which fluctuates seasonally from about 1232 to 1234 ft. The aquifer is hydraulically separated somewhat from the underlying Roza (upper-most basalt) aquifer and is the uppermost water-bearing interval in the northern end of the landfill.

The lateral extent of the aquifer in the Hole is likely limited by the side walls of the depression which appear to rise up to 1240 ft (above the highest water level measured in the Hole). However, this is not conclusive because there are not enough depth to bedrock data to resolve the detailed structure. Lateral pathways out of the Hole could occur within unidentified erosion channels in the basalt surface. The most likely direction for such an erosional channel appears to be southwest (**Figure 2).** There may also be other locations within the northern part of the site where saturation occurs above the basalt surface, either within isolated depressions or connected through erosional channels. A recently installed gas extraction well (GE-8) on the northern part of the site encountered water at an elevation of 1253 ft, and wet sand and gravel were encountered above the basalt at an elevation of about 1250 ft during drilling of monitoring well MW-4c (**Figure**

2). However, three of the recently installed gas probes and extraction wells (GE-9, GE-32, and GP6) were drilled to the basalt surface on the northern part of the site without encountering water (**Figure 2**), suggesting saturation above the basalt on the northern part of the site is discontinuous and/or ephemeral.

The transmissivity of saturated refuse and outwash in the Hole is between 4,500 gallons per day per foot (gpd/ft) and 5,900 gpd/ft based on drawdown and recovery data from a pump test conducted in EW-1 (PGG, 2002). Significant water level declines will likely occur in this aquifer during extended pumping at EW-1 as a result of its limited lateral extent. Extended pumping at EW-1 will only be possible at very low discharge rates, on the order of 1 to 2 gallons per minute (gpm).

4.1.4.3 Roza Aquifer

The Roza aquifer is the uppermost confined basalt aquifer at the northern end of the Site and is separated from the overlying aquifer in the Hole by basalt. Extraction well EW-2 and all b-series wells are completed in the Roza aquifer.

The top of the Roza aquifer occurs at an elevation ranging from about 1205 to 1220 ft on the northern part of the Site. There is a downward hydraulic gradient between groundwater in the Hole and the underlying Roza aquifer. There is also a downward hydraulic gradient between groundwater in the Roza aquifer and the underlying Interflow aquifer. Groundwater head in the Roza aquifer is up to 50 ft higher than head in the Interflow and Outwash aquifers.

Transmissivity calculated for the Roza aquifer from a pump test of EW-2 (PGG, 2002) ranges from about 6,300 gpd/ft to 188,000 gpd/ft based on a range of aquifer responses observed in EW-2, MW-3b, MW-7b, and MW-9b. The large range in transmissivity represents variations in hydraulic conductivity and aquifer thickness. Transmissivity is greatest near the extraction well and is very low near well MW-5c and decommissioned well MW-8b where the aquifer pinches out and has lower hydraulic conductivity and thickness (**Figure 4**). A representative transmissivity for the aquifer is about 23,000 gpd/ft based on a geometric mean of available data.

Calculated storativity is low, ranging from 3.0×10^{-4} to 1.9×10^{-6} with a geometric mean of 2.1×10^{-5} indicating confined aquifer conditions. However, high water levels appear to correlate with high contaminant concentrations in some of the Roza aquifer wells (see water quality section below), which is most typical for an unconfined aquifer.

The horizontal hydraulic gradient in the Roza Aquifer is relatively flat, with less than 0.5 ft head difference commonly observed between Roza monitoring wells MW-3b, MW-7b, and MW-9b.

The Roza aquifer is highly heterogeneous and is bounded by lateral discontinuities that may act to “hold up” groundwater in the Roza. The aquifer boundaries observed in pumping test data of EW-2 are caused by thinning of the Roza aquifer to the east in the vicinity of decommissioned well MW-8b and to the south in the vicinity of MW-5c (**Figure 4**). The aquifer is also bounded to the west of the landfill in the vicinity of MW-18a by silt within the buried coulee that appears to truncate the aquifer. The upgradient (northern) extent of the Roza aquifer is not defined.

4.1.4.4 Interflow Aquifer

The Interflow aquifer is a confined basalt aquifer that occurs below the Roza aquifer with a top elevation ranging from about 1120 to 1170 feet. It underlies the entire northern part of the landfill, but to the south may sub-crop into the Outwash aquifer in the vicinity of MW-22c and MW-6c.

The horizontal hydraulic gradient in the Interflow aquifer is relatively flat, with less than 1 ft of head difference commonly observed between the Interflow monitoring wells on the site. A downward hydraulic gradient also likely occurs between groundwater in the Interflow aquifer and deeper underlying basalt aquifers.

Groundwater in the Interflow aquifer discharges into the Outwash aquifer along a subsurface erosional unconformity in the vicinity of MW-22c and MW-6c. Only 2 ft of hard basalt occurs between the Outwash aquifer and the Interflow aquifer at MW-22c, and about 10 ft of soft weathered basalt occurs between the overlying Outwash aquifer and the Interflow aquifer at MW-6c. Groundwater elevations and seasonal fluctuations in the Interflow aquifer are very similar to those observed in the Outwash aquifer suggesting good hydraulic connection.

Interflow aquifer transmissivity was measured in three very short aquifer tests at wells MW-4c, MW-5c, and MW-6c. Calculated hydraulic conductivity ranged from 1 ft/day to greater than 28 ft/day at locations with aquifer thicknesses of 11 to 20 feet. Storativity was not calculated; however, storativity similar to the Roza aquifer is expected.

The Interflow aquifer is screened and sampled by the c-series wells at the site.

4.1.4.5 Outwash Aquifer

The Outwash aquifer is an unconfined aquifer that occurs in saturated sands and gravels that overlie the basalt surface on the south end of the landfill and to the west of the site beneath Highway 28 in the buried coulee. The Outwash aquifer is recharged by canal leakage and lateral groundwater flow from the Interflow and/or Roza aquifers where they sub-crop to the outwash sediments.

The horizontal hydraulic gradient in the Outwash aquifer is relatively flat, with less than 0.5 ft of head difference commonly observed between all the Outwash aquifer monitoring wells on the Site. The vertical gradient between the Interflow and Outwash aquifer is also low and may vary with the irrigation seasons.

A single, brief, low-stress aquifer test at MW-6a suggests an aquifer hydraulic conductivity on the order of 110 ft/day. The Soil Survey of Grant County estimates a hydraulic conductivity of nearly 300 ft/day. Estimates of storativity are not available for the Outwash aquifer, but are likely consistent with unconfined aquifer conditions.

The Outwash aquifer is screened and sampled by the a-series wells at the site.

4.1.4.6 Groundwater Flow Paths

Groundwater recharges the aquifers beneath the site mainly from lateral groundwater flow moving into the site from the north (**Figure 4**). The Roza aquifer has the highest on-site groundwater head and is limited to the northern part of the landfill. Groundwater from the Roza discharges vertically downward to the Interflow aquifer and possibly to the west into the Outwash aquifer where the buried coulee truncates the Roza aquifer. However, poor hydraulic connection to the Outwash and Interflow aquifers limits groundwater discharge rates from the Roza aquifer and causes heads within it to be about 50 ft higher relative to other on-site aquifers. The poor hydraulic connection is caused by pinch-out of the Roza aquifer to the south and east, and by the presence of silt abutting the aquifer in the buried coulee to the west.

Groundwater in the Interflow aquifer moves generally towards the south (**Figure 4**) and may sub-crop in the vicinity of MW-22c and MW-6c where it discharges into the Outwash aquifer. Some vertical flow also likely occurs to underlying basalt aquifers.

Groundwater in the Outwash aquifer is derived mainly from surface sources (leaking canal and irrigation) and discharging groundwater from the sub-cropping basalt aquifers on and off site. Flow direction is generally towards the south (**Figure 4**). The horizontal gradient in all aquifers is quite low (less than 0.5 ft difference between aquifer wells across the site) and variations in flow directions are pronounced.

4.2 GROUNDWATER QUALITY

Groundwater monitoring data have been collected from the site since 1989. Groundwater quality, trends, and possible sources of contamination and transport for each aquifer are discussed below. The order of presentation is generally upgradient-to-downgradient, although the Outwash aquifer (presented last) is not downgradient of the Frenchman Springs aquifer (presented second to last). For comparison purposes, **Tables 1, 2, and 3** summarize all constituents known to exceed either State Groundwater Contaminant

Levels (GWCL) from WAC 173-200 or MTCA Method B WAC 173-340-720 cleanup levels, except for samples from the Frenchman Springs aquifer. The GWCLs are the threshold concentrations that establish a corrective action requirement under the solid waste permitting regulation WAC 173-351 (and other State waste discharge permit programs). The MTCA cleanup levels are used within corrective action programs to define the extent of the cleanups. Since the purpose of Tables 1, 2, and 3 is to identify a preliminary set of contaminants of concern for the RI/FS, both the GWCL and MTCA Method B criteria are used therein; however, for purposes of defining cleanup requirements within this RI/FS, only the MTCA Method B cleanup levels will be used.

4.2.1 The Hole

Sampling of extraction well EW-1 (the Hole) in 2001 for organic and inorganic compounds (**Table 1**) showed high concentrations of leachate indicator parameters (e.g., total dissolved solids (TDS), chloride, sulfate, iron, manganese, and sodium). The 2001 sampling round also showed elevated concentrations of volatile organic compounds (VOCs) including vinyl chloride at up to 61 micrograms per liter (ug/L). Vinyl chloride concentrations increased from 21 ug/L to 61 ug/L during the 26-hour pumping test at EW-1, likely due to the variable nature of refuse material surrounding the extraction well.

4.2.2 Roza Aquifer

In general, the Roza aquifer contains lower concentrations of leachate indicator parameters compared to groundwater in the Hole at EW-1. In the vicinity of MW-3b, MW-7b, and MW-9b, the Roza aquifer is contaminated with numerous VOCs including 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), chloroethane, 1,2-dichloropropane, vinyl chloride, benzene, and 1,4-dichlorobenzene at concentrations that recently exceeded GWCL and/or MTCA method B cleanup standards (**Table 1**). MW-3b and MW-7b are also contaminated with methylene chloride at concentrations exceeding the standards, and MW-9b is contaminated with tetrachloroethene (PCE) and trichloroethene (TCE) at concentrations exceeding the standards. Chloroethane and vinyl chloride are likely breakdown products of source chlorinated solvents. In general MW-3b and MW-7b have higher concentrations of organic compounds than MW-9b (except for PCE and TCE) suggesting the main source of contamination is closer to these wells.

Extraction well EW-2 (Roza aquifer) was sampled for VOCs during a single pump test in 2001 (**Table 1**). 1,1-DCA, 1,2-DCA, chloroethane, 1,1-DCE, PCE, TCE, vinyl chloride, and 1,2-dichloropropane were detected at levels above the GWCL and/or MTCA method B cleanup standards (**Table 1**).

A number of geochemical indicators suggest natural attenuation of organic compounds is occurring within the Roza aquifer at the site, although the details/causes of the attenuation are not clear. Time series plots of most chlorinated organic compounds show a general decreasing trend to lower levels and or non-detects over time since monitoring began in these wells. A distinct decrease in trichloroethane (TCA) and 1,1-DCA with a corresponding increase in chloroethane in MW-3b and MW-7b suggest natural dechlorination reactions are occurring in the aquifer at these locations. A corresponding rise in total iron in these wells may indicate iron reduction is the dominant redox reaction occurring.

There is evidence that the source of VOC contamination may occur as a free product or other residual in the unsaturated zone above the water table. A noticeable relationship between short-term increases in organic contamination concentrations and above-normal groundwater levels is evident in all three wells suggesting the presence of a smear zone at the capillary fringe. This observation is not expected given the nominally “confined” nature of the Roza aquifer.

High concentrations of inorganic constituents also occur in the Roza aquifer. Chloride, sulfate, and corresponding total dissolved solids (TDS) in MW-3b, MW-7b, and MW-9b all exceed the GWCL and/or MTCA method B cleanup standards (**Table 1**). Sulfate and TDS concentrations also exceed the standards in off-site Roza well MW-19b. Dissolved arsenic, total iron and total manganese exceed the standards in some of the Roza wells (**Table 1**). The concentration of arsenic across the site is fairly constant in all aquifers and is likely a naturally occurring contaminant. High levels of total iron and total manganese in the Roza aquifer wells may be related to the low redox state of the aquifer.

The source of contamination in the vicinity of Roza aquifer wells MW-3b, MW-7b, and MW-9b is likely a combination of solvents, pesticides, petroleum products, and leachate. With the exception of PCE and TCE these contaminants likely occur in higher concentrations in the vicinity of MW-3b and MW-7b with mass transport possibly carrying contaminants down-gradient to MW-9b. A separate source of PCE and TCE may occur nearer to MW-9b.

4.2.3 Interflow Aquifer

Low levels of VOC groundwater contamination occur in the Interflow aquifer beneath the site. Interflow aquifer wells MW-2c, MW-5c and MW-22c have concentrations of 1,1-DCA and PCE that marginally exceeded GWCL and/or MTCA method B cleanup levels recently (**Table 2**). MW-5c also has concentrations of 1,2-DCA, 1,2-dibromoethane, TCE and 1,2-dichloropropane marginally exceeding the standards. MW-22c also has concentrations of TCE marginally exceeding the standards. Except for PCE and TCE in MW-5c and MW-22c the concentrations of VOCs in these wells are three to four times lower than the concentrations found in the Roza aquifer wells described above.

Concentrations of VOCs in the Interflow aquifer are relatively constant or slightly increasing over time. A few low level VOC detections occurred in MW-6c and MW-4c in the mid to late 1990's, but currently there are no organic compounds from these wells above the detection limit. The two other interflow aquifer wells, MW-20c and MW-21c, are located off-site to the northwest and west respectively, and except for some low levels of polycyclic aromatic hydrocarbons (PAH) detected in MW-20c in 2000 and 2001, these wells show no detections of organic compounds.

The source of VOC contamination in MW-2c, MW-5c, and MW-22c is likely from vertical movement of contaminated groundwater from the overlying Roza aquifer. MW-2c is located east of the old landfill, MW-5c is located west of the old landfill, and MW-22c is located south of the old landfill upgradient of the new landfill.

Chloride concentrations in MW-2c, MW-5c, and MW-22c have increased over time since monitoring began, with levels in MW-2c and MW-5c exceeding GWCL and/or MTCA method B cleanup levels (**Table 2**). The source of chloride is likely leachate from the old landfill following the same pathway as the VOCs.

Nitrate concentrations in off-site monitoring well MW-21c are currently an order of magnitude higher than any other monitoring well (on and off-site) and exceed GWCL and/or MTCA method B cleanup levels (**Table 2**). Nitrate levels in this well have increased from below 10 to over 70 mg/L since monitoring of this well began in 2000. The source of nitrate contamination may be the manure from the old chicken farm up-gradient to the north, or some other off-site source. An on-site source is highly unlikely given the flow directions and chemical concentration gradients. The groundwater migration pathway of nitrates to MW-21c is not known at this time. Nitrate concentrations in the overlying Outwash aquifer in the vicinity of MW-21c (MW-17a and MW-18a) are relatively low (below 5 mg/L as N). Total manganese concentrations in MW-21c also exceed GWCL and/or MTCA method B cleanup levels (**Table 2**), but have shown a declining trend from 1000 to 250 mg/L since monitoring began in 2000.

It is currently not known whether organic or inorganic contaminants occur at concentrations above standards down-gradient of wells MW-2c, MW-5c, and MW-22c in the Interflow aquifer on the site.

4.2.4 Deeper Basalt Aquifers

Deeper basalt aquifers (greater than 300-ft bgs) occur below the Interflow aquifer, but are not currently monitored. Vertical transport of contaminants to the Frenchman Springs aquifer occurred historically and locally through the open borehole of 33E1. Vertical migration through vertical fractures in basalt aquitards is also possible, but not dominant given the thick sequence of basalt aquitards separating the aquifers.

Groundwater quality data for the Frenchman Springs aquifer are available from three nearby locations: wells 33E1 (old landfill supply well), 33M1 (new landfill supply well), and 32A2 (Atkins new well). Water pumped from 33E1 in 1989 contained inorganic and organic contaminants at concentrations well above cleanup levels, and in some cases similar to concentrations in the Roza aquifer (B&V and PGG, 1990b) which should have been sealed-off in that well as a result of seal improvements in 1986. The high concentrations suggest that the seal improvements of 1986 were not successful in preventing vertical migration of Roza groundwater within the borehole. Therefore, these groundwater quality data are representative of water in the 33E1 well bore at that time, but not the Frenchman Springs aquifer in general. Although the concentrations from that sample do not reflect general deep aquifer conditions, they do indicate a point-source of contamination to the Frenchman Springs aquifer at the location of 33E1 beginning in 1974 and extending until 1993 when the well was pressure grouted and decommissioned.

Atkins' new well (32A2) was sampled in 1986 for seven inorganic parameters (NHS Inc. 1986), and in 1989 for volatile organic parameters (B&V and PGG, 1990b). The inorganic data do not clearly indicate the presence of landfill contaminants; however, three volatile organic compounds were estimated to occur (in the absence of blank contamination) below the practical quantitation limit and below cleanup levels.

Water quality samples collected during installation of new landfill water supply well 33M1 contained low levels of benzene (1.3 ug/L) and tetrachloroethene (1.7 ug/L) in the Frenchman Springs aquifer (PGG, 1993). A general lack of benzene in the upgradient Interflow aquifer, and the potential presence of benzene in air and fluids circulated during drilling of 33M1, suggest the benzene in the sample may not have been derived from the aquifer. However, a pathway through the 33E1 borehole that directly connected the Roza and Frenchman Springs aquifers could explain the presence of benzene. Tetrachloroethene is documented within both the Roza and Interflow aquifers.

4.2.5 Outwash Aquifer

Low level VOC contamination is currently evident in Outwash aquifer well MW-6a. However, in 1999 and 2001 there were also detections of PCE in MW-10a, MW-11a, and MW-14a, and detections of TCE in MW-14a, which were marginally above the MTCA-B standard. MW-18a was sampled for VOCs in June 2000, October 2000, and April 2001. Results of those samples showed concentrations of 1,1-DCA marginally above the State groundwater quality and/or MTCA method B cleanup levels (**Table 3**). MW-18a has not been sampled for VOCs since 2001.

MW-6a is currently monitored and contains concentrations of PCE and 1,1-DCA at levels marginally above the GWCL and/or MTCA method B cleanup levels (**Table 3**). Sampling in 2000 and 2001 also indicated 1,1-DCE marginally above the standards and sampling in 1999, 2000 and 2001 indicated TCE marginally above the standards.

The source of low level VOC contamination in the Outwash aquifer may be from contaminants migrating in the Roza and Interflow aquifers and then discharging into the Outwash aquifer where the basalt aquifers sub-crop into the outwash.

MW-6a also contains concentrations of chloride, nitrate, TDS, and dissolved arsenic above the GWCL and/or MTCA method B cleanup standards (**Table 3**). MW-6a began a sudden increasing trend in a number of inorganic parameters in July 2003, including chloride, nitrate, barium, calcium, cobalt, copper, magnesium, nickel, and sodium. The source of the increase may be from enhanced leaching of fertilizers applied to poplar trees planted along the property boundary in 2002, or from enhanced leaching of refuse from water applied to a large fire that occurred in 2002. No other wells have shown a similar sudden increase.

Elevated concentrations of arsenic occur in all outwash aquifer wells at levels exceeding the GWCL and/or MTCA method B cleanup level (**Table 3**). The concentration of arsenic across the site is elevated and fairly constant within each aquifer, suggesting a naturally occurring constituent.

Except for one sampling event in 2001 for bis(2-ethylhexyl) phthalate in MW-14a which exceeded the GWCL, no organic constituents have been detected above the standards in down-gradient Outwash aquifer wells MW-1a, MW-10a, MW-11a, MW-14a and MW-23a. Also, total iron, total manganese, and TDS are the only inorganic parameters, besides naturally occurring arsenic, which occasionally exceed the GWCL in some of these wells (**Table 3**), suggesting no transport of contaminants has occurred in the Outwash aquifer off site to the south.

Transport of contaminants in the Outwash aquifer off site to the east beyond MW-6a is not known. Transport of contaminants in the Outwash aquifer off site to the west beyond MW-18a is also not well known. However, MW-17a (located southwest of MW-18a) was sampled for VOCs in 2000, 2001, and 2004. Results of those samples indicated low concentrations of 1,1 DCA and 1,2 dichloropropane in 2000 and 2001 below the State groundwater quality and/or MTCA method B cleanup levels, but in 2004 no organic constituents were detected, suggesting contaminant transport in the Outwash aquifer beyond MW-18a is minimal.

4.3 PRELIMINARY CONTAMINANTS OF CONCERN

Extensive groundwater quality monitoring at the site indicates a number of chlorinated organic compounds, semi-volatile organic compounds, fuel compounds, and inorganic contaminants occur in one or more aquifers beneath the Site. To facilitate the RI/FS, a preliminary list of Contaminants of Concern (COCs) has been generated (**Table 4**).

Finalized COCs and other indicator parameters, as well as a list of analytical methods, will be defined within the sampling and analysis plan (Section 5.1 below).

The criteria for listing a parameter as a preliminary COC is that the parameter continues to exceed either GWCL or MTCA-B clean up levels (**Tables 1-3**). Exceptions to this criteria are 1,1-dichloroethene, chloromethane, and toluene, which have exceeded MTCA-B cleanup levels at least once in the past and are considered important parameters for understanding the fate and transport of particular families of organic compounds. The GWCLs are the threshold concentrations that establish a corrective action requirement under the solid waste permitting regulation WAC 173-351 (and other State waste discharge permit programs). The MTCA cleanup levels are used within corrective action programs to define the extent of the cleanups. Since the purpose of Tables 1, 2, 3 and 4 is to identify a preliminary set of contaminants of concern for the RI/FS, both the GWCL and MTCA Method B criteria are considered; however, for purposes of defining cleanup requirements within this RI/FS, only the MTCA Method B cleanup levels will be used.

Chloride, sulfate, and total dissolved solids are included in the preliminary COC as indicator parameters, and nitrate is included to investigate site-wide nitrate trends.

The COC list is only one group of analytes to be used for the RI/FS. Other groups include parameters indicative of geochemical conditions and natural attenuation, and parameters necessary to support analysis of remedies in the FS.

4.4 EVALUATION OF CLEANUP REQUIREMENTS UNDER MTCA

Cleanup levels, points of compliance, and cleanup actions will be defined based on the RI/FS and in accordance with the MTCA regulation and the WAC 173-351 permit for continued use of the site for solid waste management. The sole basis for cleanup of groundwater will be MTCA cleanup requirements. Although actions to prevent ecologic and human health risks from direct soil contact and landfill gas contact will also meet MTCA standards, actions for those pathways have already been designed, primarily using solid waste engineering criteria and regulations (under WAC 173-351). Direct contact with soils will be prevented by capping the landfill, and landfill gas will be passively vented and flared (thermally destroyed).

The 2,000 drums and/or hazardous material derived from the drums that constitute a potential continuing source of contamination will be removed to the extent practical in an interim remedial action defined in the Interim Remedial Action Plan. If during removal of drums surrounding soils are impacted, soil removal will be performed based on protection of groundwater and not soil direct contact.

As an interim action, the old landfill will be capped with natural and synthetic materials in accordance with engineering plans and specifications to be approved by Grant County Health District and Ecology. The cap will prevent wildlife and plants from being exposed to hazardous substances and will therefore likely meet the requirements for an exclusion from a terrestrial ecological evaluation according to WAC 173-340-7491(1)(b). An assessment of conformance with the exclusion requirements will be provided as part of the remedial investigation work described below.

Although removal of "hot spots" within the landfill refuse may be selected as a remedial action based on the results of the RI/FS, refuse within the municipal solid waste landfill will not be considered "soil" for the purposes of applying the MTCA regulation. Geologic materials surrounding the refuse in the vertical and lateral directions will be considered "soil." These definitions will not reduce the PLP's obligations to meet cleanup levels for soil and groundwater. Soil hot spot removal within the landfill cap area, if performed, will be based on protection of groundwater.

Under MTCA, the standard point of compliance for groundwater would be throughout the site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected by the site. However, it is likely that it is not practicable to meet the groundwater cleanup levels at the standard point of compliance within a reasonable restoration timeframe. Therefore, a conditional point of compliance on County property will likely be proposed in accordance with WAC 173-340-720(c). Cleanup levels for groundwater will be based on drinking water criteria as implemented in MTCA Method B (WAC 173-340-720).

4.5 REVIEW OF POTENTIAL EXPOSURE PATHWAYS

To fill data gaps, and meet MTCA RI/FS information requirements, this section reviews the status of potential exposure pathways. The pathways are considered to be either not present currently, rendered inactive by proposed interim actions (landfill capping and landfill gas venting and destruction), or potentially active after interim action.

Potential Exposure Pathway	Status at Ephrata Landfill
Landfill gas to groundwater to human contact/ingestion	Potentially active
Soil to groundwater to human contact/ingestion	Potentially active
Soil to groundwater to off-site surface water (direct human or animal contact with off-site surface water)	Potentially active
Direct human or animal contact with landfill gas	Inactive after interim action (landfill gas control)
Direct human or animal contact with soil	Inactive after interim action (landfill capping). Conformance with standards to be confirmed.
Direct human or animal contact with on-site surface water	Not present

Except for direct exposure to soil, all of the potentially active exposure pathways involve groundwater, which may become contaminated by leaching of soil and refuse or indirectly as a result of diffusion from contaminated landfill gas. Direct exposures to landfill gas and contaminated soil are precluded by the proposed interim actions; however, an RI task will evaluate whether the interim actions support an exclusion from MTCA's terrestrial ecological evaluation requirements. Site contaminants do not directly discharge to surface waters.

4.6 DATA GAPS AND SUMMARY OF RI/FS TASKS

The scope of investigation and feasibility study tasks to be performed during the RI/FS complements the existing body of knowledge on the nature and extent of contamination summarized in sections above. The principal uncertainties for the remedial investigation at this time are:

- Detailed knowledge of the source of groundwater contamination within the Roza aquifer at the north end of the landfill.
- The lateral extent of groundwater contamination within the Interflow aquifer.
- Whether or not cleanup levels are exceeded in the Frenchman Springs aquifer.

The combination of prior information and work conducted for the RI/FS will meet the informational standards of MTCA. Principal investigation tasks to fill the data gaps listed above are:

- Observe, sample, and photograph drums removed during the interim action.
- Observe, sample, and photograph soils and rock surrounding drums removed during the interim action.
- Sample soils and/or soil gas in other potential source areas at the north end of the landfill.
- Sample groundwater along the known groundwater pathways between contaminant source areas and downgradient locations with concentrations below MTCA Method B cleanup levels.
- Further evaluate groundwater and contaminant pathways using groundwater level measurements, hydraulic conductivity measurements, and a long term aquifer pumping test.

The feasibility study will evaluate remedial alternatives in compliance with MTCA remedy selection requirements. This analysis will address the effectiveness, implementability, and cost of different cleanup technologies, ranging from aggressive removal technologies to containment and natural attenuation technologies. The presumptive remedy of capping and venting/flaring gas from the old landfill will be incorporated into considerations for additional actions. Where appropriate, the feasibility study will evaluate different remedial technologies for specific areas of the site or for different contamination levels. Specific analyses to be performed during the feasibility study include the following:

- Technology Identification and Screening
- Development of Remedial Alternatives
- Evaluation Criteria for Remedial Alternatives
- Detailed Evaluation of Remedial Alternatives
- Conclusion/Recommended Remedy

5 REMEDIAL INVESTIGATION TASKS

This section describes tasks to be undertaken during the remedial investigation. Primary tasks are those that will be performed regardless of additional information. Contingency tasks are those that may or may not be required, depending on the results of primary tasks.

5.1 PRIMARY INVESTIGATION TASKS

The following sections describe the primary investigation tasks.

5.1.1 Task 1 – Management and Planning

PLPs will communicate with Ecology, the Health District, and consultants to promote smooth progress toward project goals and to control costs. Communication will be through channels described in the Agreed Order. The following paragraphs describe additional planning documents that will guide the work.

A Combined Sampling and Analysis Plan (SAP) and Quality Assurance and Quality Control Plan (QAP) will be generated to define the details of field investigations, laboratory analyses, and quality assurance measures. They will meet or exceed requirements in WAC 173-340-820 and -830. Finalized COCs and indicator parameters[3] will be defined within the plan, as well as a list of analytical methods. Methods will be specified for a list of parameters to be analyzed in an on-site laboratory during drum excavation and exploration of other possible sources at the north end of the landfill. The draft will be submitted to Ecology for review. PLPs will address Ecology comments and submit a draft final SAP/QAP. Upon Ecology approval, the plan will be final.

A Health and Safety Plan (HSP) will be generated to define protective measures for workers during on-site RI activities. It shall meet or exceed requirements of WAC 173-340-810. The draft will be submitted to Ecology for review and comment. PLPs will address Ecology comments and submit a final SAP/QAP.

5.1.2 Task 2 – Investigate Extent of Contamination from Drums

In addition to engineering observation of the drum removal contractor, a professional will be on site during excavation to document conditions of the drums and surrounding waste, soil, and rock for purposes of the remedial investigation. Field tasks will include:

- Establishing lateral and vertical coordinates of key site features including rock outcrops, drums, and environmental samples.
- Photographing drums, drum labels, surrounding waste and soil, and rock.
- Retrieving and archiving legible drum labels.
- Sampling the contents of drums or other waste volumes for purposes of waste designation and disposal.

[3] Indicator parameters are likely to include constituents of industrial waste and leachate that are not included as COCs, but may assist with identification of the source of groundwater contamination. Possible examples are calcium, chloride, and low molecular weight fatty acids.

- Observing and sampling surrounding waste, soil, and possibly soil gas and rock to assess the limits of excavation and contaminant migration.
- Mapping, describing, and photographing newly-exposed geology.
- Observing moisture and groundwater conditions for purposes of contaminant migration.
- Identifying and locating pathways of contamination that will not be excavated and thus require exploration by other means.
- Performing or assisting with on-site chemical analyses.
- Providing environmental data to the engineering supervisor to aid in setting directions and limits of excavation.
- Assisting with project communication to the county, city, and agencies.

Work will be documented through maintenance of a daily field log, with coordinated logs of samples and photographs. A GPS-based field survey is anticipated, with lateral and vertical precisions of 5 and 2 feet, respectively. Samples will be analyzed for all or some COCs and indicator parameters, depending on the matrix, and appropriate waste designation parameters. An on-site chemical laboratory will be established to quickly analyze samples for a subset of COCs, indicator parameters, and possibly waste designation parameters. The on-site laboratory data will be used to guide further excavation. Project personnel will facilitate a discussion amongst the PLPs and Agencies to agree on the limits of excavation based on field data.

5.1.3 Task 3 – Explore for Other Contamination Sources

Backhoe test pits and soil borings will be used to sample waste and soil over an approximately triangular area at the north end of the landfill between stations MW-8b, GP-5, and MW-7b (**Figure 2**). Results of previous geophysical surveys along the northern part of the landfill (B&V and PGG, 1990b) will be reviewed to help select locations. Sample stations will be on approximately 100-ft centers. Test pits will first be used throughout the flat northwestern-most portion of that area where depth to basalt is anticipated to be less than 10 feet. Samples will be collected from the bucket within each major stratum encountered with a default sampling interval of 5 feet. This strategy should result in about 180 soil samples (including samples from the borings discussed below). The geologist will log and sample materials encountered but will not enter the pits.

A drill rig will be used to explore and sample wastes in areas where basalt is anticipated to be greater than 10 feet deep, and where basalt was not encountered in a test pit. A sonic drill rig will likely be used. General approaches to management of investigation-derived waste, sampling, and chemical analysis techniques will be as for the test pits.

All samples will be split into two aliquots: one for possible on-site analyses, and one for possible analysis by an accredited off-site laboratory. All samples will be screened in the on-site laboratory for total volatile organics, electrical conductance, and possibly other parameters. Off-site analyses of COCs by an accredited laboratory will be assigned by field and management staff based on geologic observations and on-site screening data, with the following goals in mind:

- Establish correlations between screening data and chemical specific analyses – this will require samples over a range of concentrations be analyzed on site and off site.
- Perform accredited analyses of COCs on all significantly contaminated samples.
- Perform accredited analyses of COCs on at least 36 waste/soil samples generated by this task (about 20% of the total number of samples anticipated).

Wastes and soil will be stockpiled on liners next to each test pit and boring. The explorations and wastes will be temporarily secured pending waste screening. Excavated materials that are contaminated based on on-site screening will be disposed to the lined landfill cell. Uncontaminated waste and soil may be used to backfill test pits and borings. Groundwater is not anticipated in the borings; however, if groundwater is encountered, a monitoring well will be constructed in lieu of backfilling[4]. No permanent wells will be allowed within the new landfill access road alignment that will traverse this area.

The locations of all explorations will be surveyed by field staff using GPS.

In addition, soil and landfill gas samples will be collected from temporary samplers installed in borings and test pits, and from permanent gas probes and wells. Samples will be analyzed for volatile organic compounds, COCs, and indicator parameters.

5.1.4 Task 4 - Delineate Groundwater Contamination

Additional groundwater monitoring wells will be installed to delineate areas with exceedences of MTCA cleanup levels in groundwater. Locations for additional wells are summarized below and shown on Figure 2:

- Interflow Aquifer well east of MW-2c on County property
- Interflow Aquifer wells near MW-11a and MW-10a on County property if possible
- Frenchman Springs aquifer well near MW-5c

[4] A variance from well construction standards may be necessary to construct a well through waste.

- Roza aquifer well (vertical) southwest of MW-9b on County property; and two angle core holes projecting under the drums from the north (County property)

Drilling of vertical wells will be performed with an air rotary drill rig. Samples of soils will be described but not retained. Two-inch diameter monitoring wells will be constructed in accordance with WAC 173-160. Drill cuttings will be spread at the wellhead. Wells will be developed for sampling, equipped with Grundfos sampling pumps, and briefly tested to assess aquifer properties and appropriate sampling flow rate.

Groundwater from the boring advanced into the Frenchman Springs aquifer will be sampled at each major aquifer within the Frenchman Springs to a depth of 375 feet, with water analyzed with rapid turnaround for indicator parameters and VOCs. Results of water quality analyses, groundwater head, and the boring log will be used to design either a single completion monitoring well, or a multi-port sampler using the FLUTe (www.flut.com) system or similar. Potential FLUTe sampling ports could extend from the elevation of the (pinched-out) Roza aquifer at about 100 feet depth to the bottom of the boring.

Two angle core borings will be advanced under the drums with the goal of identifying possible vertical contamination migration pathways within basalt that underlies the drums. The borings will be continuously cored within the basalt, with cores logged and stored in boxes. Rock samples or wipe samples may also be analyzed for contaminants if feasible based on field geologist observations. Angles between 30 and 45 degrees from the vertical will be used, with the horizontal dimension toward the south (under the drums).

The borings will be completed as single or multiple-completion groundwater sampling stations using a FLUTe system or similar. A request for variance from WAC 173-160 well construction standards will be submitted for the small diameter and/or multiple completions prior to construction. The field geologist will specify FLUTe construction details based on the core log.

Measuring points will be established at all wells, and be surveyed by a County crew.

New and existing wells will be sampled once for COCs and indicator parameters, and up to three more times (quarterly) for COCs and indicators detected in the first round.

Based on likely remedies for the site, which could include monitored natural attenuation and/or groundwater pump and treat with effluent disposal by evaporation, groundwater sampling will include the following parameters in addition to COCs and indicator parameters:

- Odor (qualitative)
- Dissolved oxygen (using field flow through cell)

- Redox potential (using field flow through cell)
- Sulfide, including H2S (using field flow through cell)
- Total non-methane organic hydrocarbons
- Biological Oxygen Demand (BOD5)
- Metals, as both total and dissolved metals
- Pesticides/Herbicides (specifically including aldrin, chlordane, DDE, DDT, Dieldrin, Lindane, Heptachlor, and hydrazine).
- Aldehydes, including acetaldehyde and formaldehyde
- Ethane/ethene
- Nitrate/Nitrite/TKN
- Total phosphorus and ortho-phosphorus
- Dissolved Methane
- Hydrogen (nM)
- Gasoline/Diesel

For the potential evaporation water disposal remedy, DO, redox, and sulfide are of interest to determine if the groundwater is in a reducing state that might cause significant odors to be released from an open pond. Total non-methane organic hydrocarbons would indicate the maximum quantity of volatile organic compounds that might evaporate. BOD5 would allow the pond to be sized to ensure sufficient surface area to prevent excessive biological growth/anaerobic conditions. Pesticide/herbicides and aldehydes are of interest as these compounds have extremely low air quality standards. Ecology may not allow evaporation of these compounds directly to the atmosphere (treatment may be necessary if they are present). Total metals will be important should the pump and treat effluent be discharged to the City of Ephrata Publicly Owned Treatment Works (POTW). All of the listed parameters would be useful for assessing in-situ bioremediation. Specifically, ethane/ethene are indicators of the successful natural biological dechlorination of contaminants.

5.1.5 Task 5 – Exclusion from Terrestrial Ecological Evaluation Assessment

Once the extent of contamination has been delineated, an assessment conforming to the requirements for an exclusion from the Terrestrial Ecological Evaluation Assessment (WAC 173-340-7491) will be performed. It is anticipated that capping of the old landfill will preclude direct contact of wildlife and plants with contamininated soil and meet the requirements for an exclusion according to WAC 173-340-7491(1)(b).

5.1.6 Task 6 – Pump Groundwater from the Hole

To investigate pathways of contamination in the vicinity of the old landfill, groundwater will be pumped from the Hole for a fixed period of time (to be specified later – but anticipated to be weeks and months duration) or until water treatment and disposal are no longer feasible. Well EW-1 will be pumped at anticipated rates of between 1 and 2 gallons per minute continuously. Drawdown and discharge will be measured in EW-1, with one Roza aquifer well also monitored for drawdown. Measurements of discharge and groundwater levels within and near the Hole will be used to interpret the connectivity of that groundwater body to other bodies and to assess potential contaminant pathways.

Water will be disposed in accordance with the approved SAP, with disposal likely occurring by evaporation in a lined pond. Thus, this test may occur in the spring, summer, and fall months. Air quality permit requirements will be evaluated for this disposal method.

Key water quality parameters will be sampled infrequently over the duration of the test.

5.2 CONTINGENCY INVESTIGATION TASKS

Depending on the results of the primary investigation tasks, additional field tasks may be required to meet MTCA remedial investigation standards. Upon completion of the primary investigation tasks (only one round of well sampling), PLPs will summarize field information in a technical memorandum that also identifies remaining data gaps, if any. The memo will be submitted to the Agencies for review and comment. Based on the memo and MTCA information requirements, the PLPs and Agencies shall seek agreement on any further remedial investigation tasks.

6 DATA MANAGEMENT, REPORTING, AND QA/QC

The following sections describe how data collected during the remedial investigation will be managed, reported, and quality assured.

6.1 DATA MANAGEMENT

The following data management tools will be used to archive all data collected during the remedial investigation:

- Field logs will be photocopied weekly and mailed or faxed to an off-site location.

- A soils and gas database similar to the existing groundwater quality database will be established. Data to be imported into the database will include: coordinates of key site locations; station IDs; and all soil and gas sampling results (both field and laboratory analyses).
- Groundwater quality data will be imported into the existing groundwater database.
- Field photos of drum removal and soil excavations will be categorized and archived digitally.
- Daily field logs documenting field activities, soil pit and borings, and other key observations will be copied and kept on file.
- All borings and well designs will be constructed and archived in a digital format.
- All aquifer pumping test data, including pumping from the Hole, will be input into an MS Excel spreadsheet and time drawdown plots will be constructed.
- Pacific Groundwater Group performs daily backups and monthly archiving of networked hard drive contents. In addition, project directories will be backed-up to compact disks weekly.

6.2 REPORTING

Data collected during the primary and subsequent contingency remedial investigations will be summarized in the RI/FS report. The report will include tabular and graphical summaries of all chemical testing data (field and laboratory), test pits and borings, well logs, and aquifer test data.

6.3 QA/QC

Standard quality control/quality assurance (QA/QC) procedures of the analytical laboratories such as running laboratory blanks, duplicates, matrix spikes, and surrogate analyses will be performed in accordance with a QA/QC plan included with the sampling and analysis plan. Laboratory reports and QA/QC summaries will be attached to the final RI/FS report as appendices.

7 FEASIBILITY STUDY TASKS

The following sections describe tasks to be performed as part of the feasibility study.

7.1 TECHNOLOGY IDENTIFICATION AND SCREENING

The FS will identify remedial technologies applicable to the various media and areas at the Site and rank the technologies based on three criteria, as indicated below:

Criteria	Definition	Rankings
Technical Feasibility	Engineering issues including the ability of the technology to function effectively and achieve meaningful progress in a timely manner toward remediation goals, based on contaminant characteristics and concentrations and site conditions.	Feasible, Infeasible
Implementability	Administrative issues including regulatory approvals, schedule, constructibility, access, monitoring, operation & maintenance, community concerns, and other factors.	Implementability issues will be noted.
Cost	Relative cost including capital and future annual operating, maintenance, and monitoring costs.	Low, Medium, High, Prohibitive

As part of the screening, each technology will be retained or not retained. Retained technologies will be assembled into remedial alternatives. The following presents a preliminary identification and screening of technologies. Technologies are grouped into three general categories:

1. Additional Source Control Elements
    - Excavation of Hot Spots in Refuse – Anticipated to be feasible and implementable, but may be screened out due to high cost.
    - Excavation of all refuse – This technology will be screened out due to implementability concerns and high cost.
    - Active landfill gas treatment (the need for this technology depends on whether the conceptual site model identifies landfill gas migration as a contaminant migration pathway).
2. On-Site Groundwater
    - Monitored Natural Attenuation (MNA) – Retained
    - Groundwater Physical Containment – Anticipated to be screened out as technically infeasible in basalt due to the complex bedrock environment; however, maybe applicable in limited areas of refuse/outwash.

- Groundwater Pump and Treat – Retained
    - Extraction from the Hole year-around, as compared to seasonally for the interim action.
    - Extraction from the Rosa aquifer as needed to provide plume hydraulic containment/treatment.
    - Treatment/Water Disposal Options (The following options will be screened and one option will be carried forward into the remedial alternatives):
        - Extensive Treatment, Disposal by Re-injection/infiltration (no surface water discharge point is available at or near the site).
        - Mid-Level Treatment, Disposal To City of Ephrata POTW
        - No Treatment or Low-Level Treatment, Disposal by Evaporation
- In-situ Treatment – Applicable technologies will be identified, but will likely be screened out as infeasible due to the complex hydrogeology and mix of contaminants.

3. Off-Site Groundwater
- MNA – Retained.
- Groundwater Pump and Treat – It is anticipated that groundwater pump and treat from the downgradient Interflow and Outwash aquifers (beyond the landfill property boundary) will be screened out due to high cost. The downgradient aquifers have high transmissivity, resulting in high groundwater pumping rates to control a plume.
- In-situ Treatment – Will be screened out due to dilute contaminant concentrations in off-site aquifers.
- Point Source Treatment (well-head treatment)/Alternative Water Supply – Technologies for existing off-site groundwater wells will be identified and screened. Treatment alternatives could include reverse osmosis and/or carbon adsorption (zeolite for vinyl chloride). Alternative water supply technologies could include bottled water or a new well in a deeper aquifer, or extension of public water supply. One treatment or alternative water supply option will be selected.

7.2 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The second stage of remedy evaluation within the FS will be to present the remedial alternatives developed from the technologies that passed the screening process and identify fundamental assumptions and design parameters that will be applied to all alternatives. These items include specific average and maximum concentration for each contaminant, landfill leachate release rates, aquifer and groundwater physical parameters, groundwater travel times, and similar factors. The remainder of the section will be devoted to describing each remedial alternative, including providing feasibility study level design parameters and costs of remedial actions and treatment systems, estimating the time to reach cleanup levels, identifying appropriate institutional controls, and discussing implementability factors, advantages, and disadvantages. Probable remedial alternatives are:

Alternative	No Action	Waste Hot Spot Removal	Active LF Gas System*	MNA On-Site	MNA Off-Site	On-Site GW Pump/Treat (Hole – annually vs seasonable for IRA)	On-Site GW Pump/Treat (Roza)	Well-head Treatment/Alternative Water Supply
Alt. 1 - No Action	X							
Alt. 2 – MNA I				X	X			X
Alt. 3 – MNA II		X	X	X	X			X
Alt. 4 – Pump & Treat I					X		X	X
Alt. 5 – Pump & Treat II					X	X	X	X
Alt. 6 – Pump & Treat III		X	X		X		X	X

* Use of Active LF Gas System depends on the differences between performance of passive and active systems.

The description of MNA for Alternatives 2 and 3 will address the criteria for natural attenuation listed in WAC 173-340-360. Groundwater capture zones for the groundwater pump and treat alternatives will be determined through groundwater modeling. Cost estimates and conceptual designs will be prepared for each alternative. The format of the cost estimates will allow for direct comparison of costs between each alternative, and will include initial capital and future operation, monitoring, and maintenance costs based on the estimated duration of the remedial action.

7.3 EVALUATION CRITERIA FOR REMEDIAL ALTERNATIVES

The third step in the FS will identify and define the remedial alternative evaluation criteria in accordance with MTCA requirements. These criteria are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Short-term effectiveness
- Long-term effectiveness
- Reduction of toxicity, mobility, and volume through treatment (permanence)
- Implementability
- Cost
- Community concern

7.4 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

The fourth step of the FS will evaluate the remedial alternatives using the remedial alternative evaluation criteria. Each alternative will be evaluated using each criterion with a scoring system of 1, 2 or 3. The scoring system will be defined in the text. Costs will be compared (as present worth costs). A disproportionate cost analysis will be prepared to evaluate the relative benefits and costs of the alternatives. The analysis will be completed in accordance with MTCA guidance.

7.5 CONCLUSION/RECOMMENDED REMEDY

The final FS step will provide conclusions of the FS and recommend a remedy based on remedial alternatives evaluation.

8 PREPARATION OF THE RI/FS REPORT

The RI/FS report will be prepared as a draft for review and comment by Ecology. Ecology will provide written comments on the RI/FS report and written responses to these comments will be provided by the PLPs. After the comments from Ecology have been addressed, a revised RI/FS report will be prepared to reflect the comments and responses from the draft RI/FS. This version of the RI/FS will be made available for public and stakeholder review during a 30-day public comment period. The RI/FS will be finalized after completion of a public comment period.

9 PROJECT SCHEDULE ISSUES

A firm project schedule cannot be established without considering coordination of RI and interim action field tasks, and management issues. The following key schedule issues are identified to assist in overall project schedule development:

- Drum removal must be contemporaneous with evaluation of environmental conditions near the drums (RI Task 2).
- Exploration for other contamination sources should follow drum removal.
- Disposal of water pumped from the hole will be by evaporation and thus limited to spring, summer, and fall.
- Contingency tasks must follow submittal and discussion of all primary RI tasks (but only one round of groundwater sampling), removal of drums, and one season of pumping water from the hole.

10 REFERENCES CITED

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TABLE 1: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Roza Aquifer

Grant County Ephrata Landfill (October 1989 through December 2005)

	STANDARDS					ROZA WELLS						
CONSTITUENT	GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	Atkins Old	EW-1 "Hole"	EW-2	MW-19b	MW-3b	MW-7b	MW-9b
Inorganics												
Chloride	250			mg/L	Total Samples	40	3	3	18	44	37	41
					Max Value	17.4	1800	960	30	1510	1180	2060
					Min Value	2.5	1600	880	18.4	70.5	9	42.48
					Most Recent Value	9.8	1600	960	20.1	472	276	1260
					GWCL Exceedances	0	3	3	0	36	29	39
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Nitrate as Nitrogen	10			mg/L as N	Total Samples	25	3	3	17	29	25	28
					Max Value	3.2	ND	0.69	0.047	2.01	6.39	20.1
					Min Value	0.004	ND	0.56	ND	ND	ND	0.016
					Most Recent Value	0.776	0	0.66	0.01	0.01	0.296	0.566
					GWCL Exceedances	0	0	0	0	0	0	2
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Nitrite as Nitrogen	10			mg/L as N	Total Samples	25	3	3	17	29	25	28
					Max Value	27.1	ND	0.064	0.01	0.02	0.056	0.354
					Min Value	ND	ND	0.032	ND	ND	ND	0.021
					Most Recent Value	0.01	0	0.064	0.01	0.01	0.05	0.093
					GWCL Exceedances	1	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Sulfate	250			mg/L	Total Samples	40	3	3	18	45	37	41
					Max Value	41.2	1200	1100	1020	1560	990	1790
					Min Value	0.525	1100	1100	290	1.689	2.216	2.935
					Most Recent Value	20.8	1200	1100	573	142	187	328
					GWCL Exceedances	0	3	3	18	28	25	38
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Total Dissolved Solids	500			mg/L	Total Samples	34	3	3	18	34	31	32
					Max Value	690	5100	3000	1750	5360	6850	11200
					Min Value	200	4400	2900	959	326	1350	440
					Most Recent Value	230	4400	3000	959	2040	1350	4020
					GWCL Exceedances	1	3	3	18	33	31	31
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Organics												
1,1,1-Trichloroethane	200		7200	ug/l	Total Samples	34	3	3	20	33	31	32
					Max Value	0.49	ND	ND	ND	390	440	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	1	2	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
1,1-Dichloroethane	1		800	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	11	24	ND	1200	340	25
					Min Value	ND	4.3	21	ND	ND	2.6	ND
					Most Recent Value	ND	11	21	ND	11	16	11
					GWCL Exceedances	0	3	3	0	40	34	34
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	1	0	0
1,2-Dichloroethane (EDC)	0.5	0.48	160	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	ND	3.1	ND	310	170	4.5
					Min Value	ND	ND	2.8	ND	ND	ND	ND
					Most Recent Value	ND	ND	2.8	ND	2.2	3.7	1.6
					GWCL Exceedances	0	0	3	0	38	32	28
					MTCA-B carcin Exceedances	0	0	3	0	38	32	28
					MTCA-B non-carcin Exceedances	0	0	0	0	2	1	0
Chloroethane		15	3200	ug/L	Total Samples	36	3	3	20	39	34	35
					Max Value	ND	3.3	21	ND	580	810	17
					Min Value	ND	1.8	17	ND	0	ND	ND
					Most Recent Value	ND	3.3	17	ND	350	140	12
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	3	0	21	18	1
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
1,1-Dichloroethene		0.073	40	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	ND	1.1	ND	6.6	110	3.2
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	1	0	20	17	14
					MTCA-B non-carcin Exceedances	0	0	0	0	0	1	0

CONSTITUENT	STANDARDS GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	ROZA WELLS Atkins Old	EW-1 "Hole"	EW-2	MW-19b	MW-3b	MW-7b	MW-9b
Tetrachloroethene (PCE)	0.8	0.081	80	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	0.64	ND	2	ND	1.3	1.2	21
					Min Value	ND	ND	1.4	ND	ND	ND	3.4
					Most Recent Value	ND	ND	2	ND	ND	ND	4.5
					GWCL Exceedances	0	0	3	0	3	2	35
					MTCA-B carcin Exceedances	1	0	3	0	6	7	35
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Trichloroethene (TCE)	3	0.11	2.4	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	ND	1.1	ND	24.8	5.4	6.4
					Min Value	ND	ND	1	ND	ND	ND	ND
					Most Recent Value	ND	ND	1.1	ND	ND	ND	1.4
					GWCL Exceedances	0	0	0	0	3	4	5
					MTCA-B carcin Exceedances	0	0	3	0	18	14	34
					MTCA-B non-carcin Exceedances	0	0	0	0	4	4	6
cis-1,2-Dichloroethene			80	ug/L	Total Samples	36	3	3	20	40	34	35
					Max Value	0.031	19	26	ND	75	72.21	109.36
					Min Value	ND	12	26	ND	ND	ND	19
					Most Recent Value	ND	19	26	ND	3	1.6	20
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	1
trans-1,2-Dichloroethene			160	ug/L	Total Samples	36	3	3	20	41	35	34
					Max Value	ND	ND	ND	ND	223	16	0.8
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	1	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	1	0	0
Vinyl Chloride	0.02	0.029	24	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	61	29	ND	680	150	70
					Min Value	ND	21	29	ND	ND	ND	17
					Most Recent Value	ND	61	29	ND	6.4	2.2	32
					GWCL Exceedances	0	3	3	0	40	33	35
					MTCA-B carcin Exceedances	0	3	3	0	40	33	35
					MTCA-B non-carcin Exceedances	0	2	3	0	20	11	26
1,2-Dichloropropane	0.6	0.64		ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	1.6	1.3	21	ND	360	240	42
					Min Value	ND	ND	18	ND	ND	ND	3.5
					Most Recent Value	ND	1.3	18	ND	5.1	4.2	5.1
					GWCL Exceedances	1	2	3	0	39	31	35
					MTCA-B carcin Exceedances	1	2	3	0	39	31	35
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Bromodichloromethane	0.3	0.71	160	ug/L	Total Samples	36	3	3	20	39	34	34
					Max Value	ND	ND	ND	ND	7	240	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	1	1	0
					MTCA-B carcin Exceedances	0	0	0	0	1	1	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	1	0
Chloromethane		3.4		ug/L	Total Samples	36	3	3	20	39	34	35
					Max Value	ND	ND	ND	ND	35	31	32
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	5	3	3
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Dichloromethane (Methylene Chloride)	5	5.8	480	ug/l	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	ND	ND	ND	24	230	21
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	18	6.8	ND
					GWCL Exceedances	0	0	0	0	7	8	2
					MTCA-B carcin Exceedances	0	0	0	0	7	8	2
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Chloroform	7	7.2	80	ug/L	Total Samples	36	3	3	20	39	34	34
					Max Value	ND	ND	ND	0.22	5	20	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	2	0
					MTCA-B carcin Exceedances	0	0	0	0	0	2	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
2-Butanone			4800	ug/L	Total Samples	31	3	3	19	32	28	29
					Max Value	0.79	ND	ND	ND	9800	2200	1.3
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	1	0	0

CONSTITUENT	STANDARDS GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	ROZA WELLS Atkins Old	EW-1 "Hole"	EW-2	MW-19b	MW-3b	MW-7b	MW-9b
4-Methyl-2-Pentanone (MIBK)			640	ug/L	Total Samples	30	3	3	19	29	28	29
					Max Value	ND	ND	ND	ND	8100	1500	0.63
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	4	2	0
Acetone			800	ug/L	Total Samples	31	3	3	19	32	29	30
					Max Value	9.6	13	ND	7	16000	7300	8.6
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	13	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	2	1	0
Benzene	1	0.8	24	ug/L	Total Samples	36	3	3	20	41	34	35
					Max Value	ND	2.6	2.3	ND	43	51	3.7
					Min Value	ND	1.2	2	ND	ND	ND	ND
					Most Recent Value	ND	2.6	2	ND	20	2.7	1.9
					GWCL Exceedances	0	3	3	0	39	31	26
					MTCA-B carcin Exceedances	0	3	3	0	39	31	27
					MTCA-B non-carcin Exceedances	0	0	0	0	5	5	0
1,4-Dichlorobenzene	4	1.8		ug/L	Total Samples	36	4	4	20	41	33	34
					Max Value	ND	1.3	1	ND	8	15	1.9
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	6.8	3.1	1.9
					GWCL Exceedances	0	0	0	0	8	8	0
					MTCA-B carcin Exceedances	0	0	0	0	15	13	2
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Ethylbenzene			800	ug/L	Total Samples	36	3	3	20	39	34	35
					Max Value	ND	ND	ND	9.7	830	680	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	9.8	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	1	0	0
Toluene			1600	ug/L	Total Samples	36	3	3	20	41	33	34
					Max Value	0.5	ND	ND	0.83	17000	5200	1.1
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	4	4	0
Bis(2-ethylhexyl) Phthalate	6	6.3	320	ug/L	Total Samples	6	3	3	4	8	6	7
					Max Value	1.8	ND	ND	9.3	15	7.3	2
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	1	1	1	0
					MTCA-B carcin Exceedances	0	0	0	1	1	1	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Acrylonitrile	0.07	0.081	8	ug/L	Total Samples	31	3	3	19	31	28	29
					Max Value	ND	ND	ND	ND	ND	ND	0.51
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	1
					MTCA-B carcin Exceedances	0	0	0	0	0	0	1
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Metals												
Antimony, Dissolved			6.4	ug/L	Total Samples	35	3	3	17	35	32	33
					Max Value	5.6	ND	ND	ND	ND	ND	9.6
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	1
Arsenic, Dissolved	0.05	0.058	4.8	ug/L	Total Samples	35	3	3	17	35	32	33
					Max Value	5.2	ND	90	ND	6	7.2	5.9
					Min Value	ND	ND	80	ND	ND	ND	ND
					Most Recent Value	4	ND	80	ND	2	2	3
					GWCL Exceedances	29	0	3	0	23	16	24
					MTCA-B carcin Exceedances	29	0	3	0	23	16	24
					MTCA-B non-carcin Exceedances	1	0	3	0	1	1	1
Barium, Total	1000		3200	ug/L	Total Samples	5	NM	NM	NM	7	4	6
					Max Value	6950	NM	NM	NM	93600	34430	29030
					Min Value	ND	NM	NM	NM	ND	ND	ND
					Most Recent Value	ND	NM	NM	NM	375	ND	200
					GWCL Exceedances	2	NM	NM	NM	1	1	1
					MTCA-B carcin Exceedances	0	NM	NM	NM	0	0	0
					MTCA-B non-carcin Exceedances	1	NM	NM	NM	1	1	1

	STANDARDS					ROZA WELLS						
CONSTITUENT	**GWCL**	**MTCA-B Carcin**	**MTCA-B Noncarcin**	**Units**	**Summary**	**Atkins Old**	**EW-1 "Hole"**	**EW-2**	**MW-19b**	**MW-3b**	**MW-7b**	**MW-9b**
Cadmium, Dissolved			8	ug/L	Total Samples	34	3	3	17	35	32	33
					Max Value	35	ND	ND	ND	0.3	0.3	8
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	1	0	0	0	0	0	0
Iron, Dissolved	300			ug/L	Total Samples	3	NM	NM	NM	4	3	3
					Max Value	80	NM	NM	NM	5770	1690	610
					Min Value	ND	NM	NM	NM	1970	8	0
					Most Recent Value	ND	NM	NM	NM	5770	1690	0
					GWCL Exceedances	0	NM	NM	NM	4	1	1
					MTCA-B carcin Exceedances	0	NM	NM	NM	0	0	0
					MTCA-B non-carcin Exceedances	0	NM	NM	NM	0	0	0
Iron, Total	300			ug/L	Total Samples	37	3	3	19	41	34	38
					Max Value	210	16400	100	2790	8600	3200	1030
					Min Value	ND	13700	90	50	ND	ND	ND
					Most Recent Value	ND	16400	90	380	3920	950	ND
					GWCL Exceedances	0	3	0	13	35	30	2
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0
Manganese, Dissolved	50		2200	ug/L	Total Samples	3	NM	NM	NM	4	2	2
					Max Value	11	NM	NM	NM	14700	13500	6490
					Min Value	2.2	NM	NM	NM	800	9900	4780
					Most Recent Value	2.2	NM	NM	NM	14700	13500	6490
					GWCL Exceedances	0	NM	NM	NM	4	2	2
					MTCA-B carcin Exceedances	0	NM	NM	NM	0	0	0
					MTCA-B non-carcin Exceedances	0	NM	NM	NM	3	2	2
Manganese, Total	50		2200	ug/L	Total Samples	37	3	3	19	40	34	38
					Max Value	4240	23000	9470	1360	21400	17700	270000
					Min Value	ND	21400	8660	86	13.3	ND	ND
					Most Recent Value	ND	23000	8660	1360	8850	6300	8580
					GWCL Exceedances	1	3	3	19	39	33	35
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	1	3	3	0	39	30	32
Selenium, Dissolved	10		80	ug/L	Total Samples	35	3	3	17	35	32	33
					Max Value	ND	ND	ND	3	6	ND	15.3
					Min Value	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	1
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)
EW-1 and EW-2 were sampled three times during a single pump test 2001

TABLE 2: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Interflow Aquifer
Grant County Ephrata Landfill (October 1989 through December 2005)

	STANDARDS					INTERFLOW WELLS							BELOW INTERFLOW
CONSTITUENT	**GWCL**	**MTCA-B Carcin**	**MTCA-B Noncarcin**	**Units**	**Summary**	**MW-20c**	**MW-21c**	**MW-22c**	**MW-2c**	**MW-4c**	**MW-5c**	**MW-6c**	**MW-16d**
Inorganics													
Chloride	250			mg/L	Total Samples	23	23	19	52	53	53	52	17
					Max Value	16	28	88.8	540	229.93	427	187.94	140
					Min Value	2.8	5.2	44	1.2	7.2	1.8	7.1	6.5
					Most Recent Value	4	5.2	88.8	469	8.9	371	11.8	54.6
					GWCL Exceedances	0	0	0	29	0	14	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Nitrate as Nitrogen	10			mg/L as N	Total Samples	19	19	17	36	37	37	36	17
					Max Value	1.14	81.1	8.29	11.4	10.3	12.2	6.05	0.034
					Min Value	0.2	21	6.8	ND	ND	0.03	0.05	ND
					Most Recent Value	1.14	81.1	8.29	9.46	ND	9.55	4.87	ND
					GWCL Exceedances	0	19	0	9	1	5	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Nitrate+Nitrite as Nitrogen	10			mg/L as N	Total Samples	23	23	19	36	36	37	36	17
					Max Value	1.2	81.1	8.32	12.1	0.1	12	6.07	0.034
					Min Value	0.2	2.23	6.8	4	ND	3.55	0.98	ND
					Most Recent Value	1.14	81.1	8.32	9.46	0.01	9.59	4.89	0.01
					GWCL Exceedances	0	21	0	19	0	3	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Nitrite as Nitrogen	10			mg/L as N	Total Samples	19	19	17	36	37	37	36	17
					Max Value	0.19	1	0.032	20.19	0.324	29.7	0.283	0.011
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	0.031	ND	ND	0.039	0.022	ND
					GWCL Exceedances	0	0	0	2	0	1	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Sulfate	250			mg/L	Total Samples	23	23	19	53	54	54	53	17
					Max Value	33.9	74.4	48.5	147	92.6	353	108	67.8
					Min Value	20.1	28.3	34	ND	0.717	1.65	0.901	3.4
					Most Recent Value	29.9	68.8	39.5	57.4	32.4	148	37.9	67.8
					GWCL Exceedances	0	0	0	0	0	2	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Total Dissolved Solids	500			mg/L	Total Samples	23	23	19	35	35	36	35	17
					Max Value	342	1080	522	1870	352	14000	618	840
					Min Value	204	240	332	480	180	388	250	330
					Most Recent Value	216	614	332	1020	200	1010	315	357
					GWCL Exceedances	0	10	1	34	0	35	2	2
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Organics													
1,1-Dichloroethane	1		800	ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	5	3.2	ND	2	3.9	0.24
					Min Value	ND	ND	3.5	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	3.9	1.7	ND	1.3	ND	ND
					GWCL Exceedances	0	0	19	31	0	25	4	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
1,2-Dibromoethane	0.001	0.00051		ug/L	Total Samples	4	4	NM	17	16	17	16	2
					Max Value	ND	ND	NM	ND	ND	0.2	ND	ND
					Min Value	ND	ND	NM	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	NM	ND	ND	0.039	ND	ND
					GWCL Exceedances	0	0	NM	0	0	5	0	0
					MTCA-B carcin Exceedances	0	0	NM	0	0	5	0	0
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	0
1,2-Dichloroethane (EDC)	0.5	0.48	160	ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	ND	0.5	ND	1.7	0.77	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	1.1	ND	ND
					GWCL Exceedances	0	0	0	0	0	37	1	0
					MTCA-B carcin Exceedances	0	0	0	1	0	38	1	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
1,1-Dichloroethene		0.073	40	ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	1.2	0.14	ND	0.8	0.88	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	6	6	0	3	2	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0

	STANDARDS					INTERFLOW WELLS							BELOW INTERFLOW
CONSTITUENT	GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	MW-20c	MW-21c	MW-22c	MW-2c	MW-4c	MW-5c	MW-6c	MW-16d
Tetrachloroethene (PCE)	0.8	0.081	80	ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	5.3	6.7	0.044	11	1.6	0.081
					Min Value	ND	ND	3.4	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	4.4	1.4	ND	9.2	ND	ND
					GWCL Exceedances	0	0	19	43	0	44	7	0
					MTCA-B carcin Exceedances	0	0	19	44	0	44	14	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Trichloroethene (TCE)	3	0.11	2.4	ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	2.9	0.82	ND	1.9	0.83	0.097
					Min Value	ND	ND	1.5	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	1.5	ND	ND	1.4	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	19	9	0	38	4	0
					MTCA-B non-carcin Exceedances	0	0	3	0	0	0	0	0
Chloromethane		3.4		ug/L	Total Samples	23	23	19	45	37	44	37	19
					Max Value	ND	ND	ND	ND	5.36	0.6	5.36	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	1	0	1	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
1,2-Dichloropropane	0.6	0.64		ug/L	Total Samples	23	23	19	46	38	45	37	19
					Max Value	ND	ND	ND	0.68	0.75	2	0.64	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	1.2	ND	ND
					GWCL Exceedances	0	0	0	3	1	40	1	0
					MTCA-B carcin Exceedances	0	0	0	3	1	40	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Carbon Tetrachloride	0.3	0.34	5.6	ug/L	Total Samples	23	23	19	45	37	44	37	19
					Max Value	ND	ND	ND	ND	ND	0.39	ND	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	1	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	1	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Chrysene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.27	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.27	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Pentachlorophenol		0.73	480	ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	1.1	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	1.1	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Bis(2-ethylhexyl) Phthalate	6	6.3	320	ug/L	Total Samples	9	9	14	8	7	8	7	12
					Max Value	2.6	ND	2	ND	ND	30	3.7	8.1
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	2.6	ND	ND	ND	ND	1.8	3.7	2.2
					GWCL Exceedances	0	0	0	0	0	1	0	1
					MTCA-B carcin Exceedances	0	0	0	0	0	1	0	1
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Benz(a)anthracene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.24	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.24	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Benzo(A)Pyrene	0.008	0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.18	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.18	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Benzo(B)Fluoranthene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.38	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.38	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM

	STANDARDS					INTERFLOW WELLS							BELOW INTERFLOW
CONSTITUENT	**GWCL**	**MTCA-B Carcin**	**MTCA-B Noncarcin**	**Units**	**Summary**	**MW-20c**	**MW-21c**	**MW-22c**	**MW-2c**	**MW-4c**	**MW-5c**	**MW-6c**	**MW-16d**
Benzo(K)Fluoranthene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.21	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.21	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Dibenz(A,H)Anthracene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.14	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.14	ND	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Indeno(1,2,3-CD)Pyrene		0.012		ug/L	Total Samples	2	2	NM	3	2	3	2	NM
					Max Value	0.33	ND	NM	ND	ND	ND	ND	NM
					Min Value	ND	ND	NM	ND	ND	ND	ND	NM
					Most Recent Value	0.33	0	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	0	0	NM	0	0	0	0	NM
					MTCA-B carcin Exceedances	1	0	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	0	0	NM	0	0	0	0	NM
Metals													
Arsenic, Dissolved	0.05	0.058	4.8	ug/L	Total Samples	23	23	18	37	36	37	36	17
					Max Value	2	2	2	4	1	4	5	2
					Min Value	ND	ND	1	ND	ND	ND	ND	ND
					Most Recent Value	2	2	2	ND	ND	2	5	2
					GWCL Exceedances	17	14	18	6	1	16	27	14
					MTCA-B carcin Exceedances	17	14	18	6	1	16	27	14
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	3	0
Barium, Total	1000		3200	ug/L	Total Samples	NM	NM	NM	12	13	12	13	NM
					Max Value	NM	NM	NM	130000	50700	90000	10720	NM
					Min Value	NM	NM	NM	ND	ND	ND	ND	NM
					Most Recent Value	NM	NM	NM	ND	ND	ND	ND	NM
					GWCL Exceedances	NM	NM	NM	3	1	2	1	NM
					MTCA-B carcin Exceedances	NM	NM	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	NM	NM	NM	3	1	2	1	NM
Iron, Dissolved	300			ug/L	Total Samples	NM	NM	NM	7	7	7	6	NM
					Max Value	NM	NM	NM	150	110	90	606	NM
					Min Value	NM	NM	NM	ND	ND	ND	ND	NM
					Most Recent Value	NM	NM	NM	35.1	13.5	ND	606	NM
					GWCL Exceedances	NM	NM	NM	0	0	0	1	NM
					MTCA-B carcin Exceedances	NM	NM	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	NM	NM	NM	0	0	0	0	NM
Iron, Total	300			ug/L	Total Samples	23	23	19	46	47	47	47	16
					Max Value	606	140	210	111	290	126	236	12900
					Min Value	ND	ND	ND	ND	ND	ND	ND	990
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	3280
					GWCL Exceedances	2	0	0	0	0	0	0	16
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Manganese, Dissolved	50		2200	ug/L	Total Samples	NM	NM	NM	6	6	6	6	NM
					Max Value	NM	NM	NM	160	39	10	52	NM
					Min Value	NM	NM	NM	ND	ND	ND	ND	NM
					Most Recent Value	NM	NM	NM	ND	27.6	ND	2.4	NM
					GWCL Exceedances	NM	NM	NM	1	0	0	1	NM
					MTCA-B carcin Exceedances	NM	NM	NM	0	0	0	0	NM
					MTCA-B non-carcin Exceedances	NM	NM	NM	0	0	0	0	NM
Manganese, Total	50		2200	ug/L	Total Samples	23	23	19	46	47	47	47	16
					Max Value	28.5	948	24	27730	10980	24830	20280	1280
					Min Value	ND	40.4	ND	ND	ND	ND	ND	151
					Most Recent Value	ND	215	5	ND	28	ND	ND	173
					GWCL Exceedances	0	22	0	3	1	2	2	16
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	3	1	2	1	0

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)

TABLE 3: Summary of Constituents Exceeding Groundwater Contaminant Levels (GWCL) and MTCA Method B in The Outwash Aquifer

Grant County Ephrata Landfill (October 1989 through December 2005)

CONSTITUENT	STANDARDS GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	OUTWASH WELLS MW-10a	MW-11a	MW-14a	MW-17a	MW-18a	MW-1a	MW-23a	MW-6a
Inorganics													
Chloride	250			mg/L	Total Samples	19	18	21	5	4	21	19	20
					Max Value	14.8	31.7	16.1	18.6	31	15	13.9	638
					Min Value	3	10.4	12.8	11.8	27	6.5	7.7	13
					Most Recent Value	13.9	10.4	12.8	11.8	31	8.6	13.9	550
					GWCL Exceedances	0	0	0	0	0	0	0	9
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Nitrate as Nitrogen	10			mg/L as N	Total Samples	17	15	19	3	2	19	17	16
					Max Value	5.47	6.3	3.3	4.4	2.5	4.86	5.39	11.2
					Min Value	2.8	4.2	1.8	2.71	1.7	2.5	3.3	3.336
					Most Recent Value	5.47	5.24	3.04	3.48	2.5	3.69	5.12	9.78
					GWCL Exceedances	0	0	0	0	0	0	0	4
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Nitrate+Nitrite as Nitrogen	10			mg/L as N	Total Samples	19	18	21	6	4	22	19	19
					Max Value	5.49	6.33	5.29	7.15	2.5	4.88	5.41	11.2
					Min Value	0.54	2.97	1.8	2.72	1.66	2.5	3.3	3.44
					Most Recent Value	5.49	5.26	3.05	3.5	2.5	3.71	5.14	9.82
					GWCL Exceedances	0	0	0	0	0	0	0	4
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Total Dissolved Solids	500			mg/L	Total Samples	19	18	21	5	4	21	19	19
					Max Value	362	432	393	374	374	330	853	2400
					Min Value	204	280	320	310	270	173	260	348
					Most Recent Value	336	358	345	352	340	173	282	1630
					GWCL Exceedances	0	0	0	0	0	0	1	14
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Organics													
1,1-Dichloroethane	1		800	ug/L	Total Samples	19	18	21	6	3	21	19	20
					Max Value	0.046	ND	0.52	0.52	1.6	ND	ND	5.3
					Min Value	ND	ND	ND	ND	1.3	ND	ND	0
					Most Recent Value	ND	ND	ND	ND	1.3	ND	ND	2.6
					GWCL Exceedances	0	0	0	0	3	0	0	19
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
1,1-Dichloroethene		0.073	40	ug/L	Total Samples	19	18	21	6	3	21	19	20
					Max Value	ND	ND	ND	ND	ND	ND	ND	0.47
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	2
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Tetrachloroethene (PCE)	0.8	0.081	80	ug/L	Total Samples	19	18	21	6	3	21	19	20
					Max Value	0.12	0.56	0.48	ND	0.057	ND	ND	1.8
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	1.2
					GWCL Exceedances	0	0	0	0	0	0	0	19
					MTCA-B carcin Exceedances	1	3	1	0	0	0	0	19
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Trichloroethene (TCE)	3	0.11	2.4	ug/L	Total Samples	19	18	21	6	3	21	19	20
					Max Value	0.051	ND	0.51	ND	0.061	ND	ND	1
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	1	0	0	0	0	5
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0

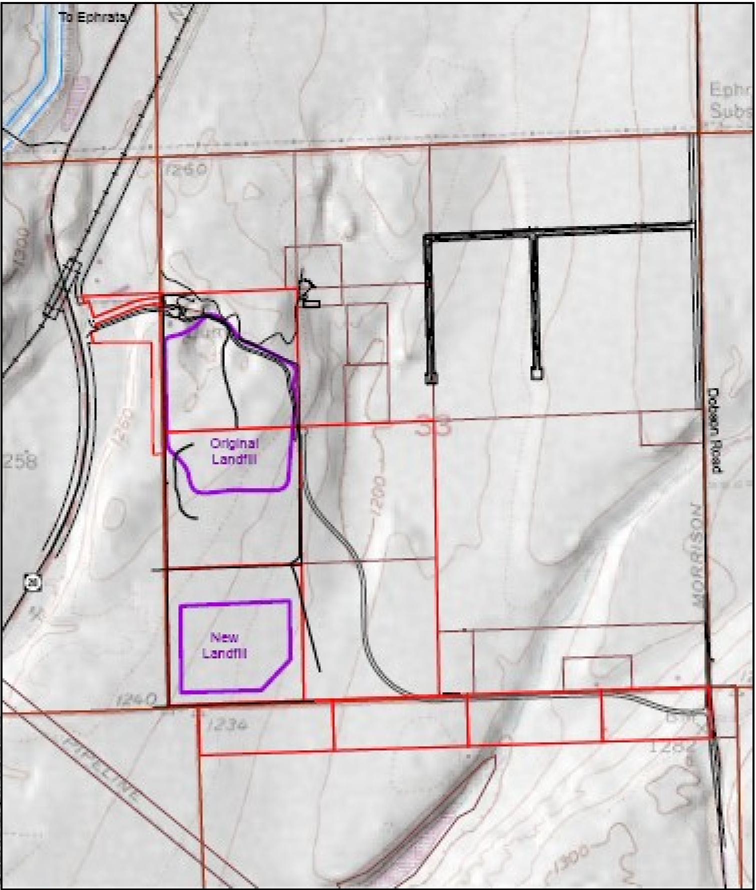
CONSTITUENT	STANDARDS GWCL	MTCA-B Carcin	MTCA-B Noncarcin	Units	Summary	OUTWASH WELLS MW-10a	MW-11a	MW-14a	MW-17a	MW-18a	MW-1a	MW-23a	MW-6a
Bis(2-ethylhexyl) Phthalate	6	6.3	320	ug/L	Total Samples	14	13	16	3	2	15	14	14
					Max Value	2	1	6.3	ND	ND	8.9	3	5.4
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	1.1	ND	ND	2.3	2.4	ND
					GWCL Exceedances	0	0	1	0	0	1	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	1	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Metals													
Arsenic, Dissolved	0.05	0.058	4.8	ug/L	Total Samples	19	18	21	5	3	21	18	19
					Max Value	6	8	5.6	6	4.5	4	5	2
					Min Value	3.4	3.6	3	5	ND	ND	2	ND
					Most Recent Value	6	8	4	6	3	3	5	2
					GWCL Exceedances	19	18	21	5	2	18	18	14
					MTCA-B carcin Exceedances	19	18	21	5	2	18	18	14
					MTCA-B non-carcin Exceedances	15	17	1	5	0	0	5	0
Iron, Total	300			ug/L	Total Samples	18	17	20	5	4	21	19	18
					Max Value	90	582	46600	75.2	386	90	270	130
					Min Value	ND	ND	ND	ND	0.15	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	210	ND	ND	ND
					GWCL Exceedances	0	1	3	0	1	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Manganese, Total	50		2200	ug/L	Total Samples	18	17	20	5	4	21	19	18
					Max Value	2	27.7	1230	50.2	380	ND	11	19
					Min Value	ND	ND	ND	ND	0.049	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	42	ND	ND	19
					GWCL Exceedances	0	0	2	1	1	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	0	0	0	0	0	0	0	0
Thallium, Dissolved			1.1	ug/L	Total Samples	19	18	21	5	3	21	18	19
					Max Value	2	ND	ND	ND	ND	ND	ND	ND
					Min Value	ND	ND	ND	ND	ND	ND	ND	ND
					Most Recent Value	ND	ND	ND	ND	ND	ND	ND	ND
					GWCL Exceedances	0	0	0	0	0	0	0	0
					MTCA-B carcin Exceedances	0	0	0	0	0	0	0	0
					MTCA-B non-carcin Exceedances	1	0	0	0	0	0	0	0

NOTES:
Shaded results indicate where an exceedance of either GWCL or MTCA-B groundwater standards have occurred at least once
ND = No Detection above limit
NM = Not Measured
MTCA-B Car = Model Toxic Control Act Method B Carcinogenic
MTCA-B Non Car = Model Toxic Control Act Method B Non Carcinogenic
GWCL = State Groundwater Contaminant Levels (WAC 173-200)

TABLE 4: Preliminary Contaminants of Concern

Inorganics	Organics	Metals
Chloride	1,2-Dichloroethane (EDC)	Arsenic
Sulfate	1,1-Dichloroethane	Iron
Total Dissolved Solids (TDS)	Chloroethane	Manganese
Nitrate		
	Tetrachloroethene (PCE)	
	Trichloroethene (TCE)	
	1,1-Dichloroethene	
	cis-1,2-Dichloroethene	
	trans-1,2-Dichloroethene	
	Vinyl Chloride	
	Chloromethane	
	Dichloromethane (Methylene Chloride)	
	Trichlorofluoromethane	
	1,2-Dichloropropane	
	Benzene	
	Toluene	
	Ethylbenzene	
	Xylene (m, p, o)	
	1,2-Dichlorobenzene	
	1,4-Dichlorobenzene	
	Bis(2-ethylhexyl) Phthalate	

NOTE:
COC organic and inorganic parameters were those that exceeded MTCA-B clean up levels most recently except 1,1-dichloroethene; chloromethane; and toluene which have exceeded MTCA-B levels at least 5 times in the past or were considered important parameters for undertanding fate and transport.



Landfill Parcels

Landfill Extents

N

0 Feet 1,000

Figure 1
Site Location

RI/FS Work Plan
Ephrata Landfill Corrective Action

PGG

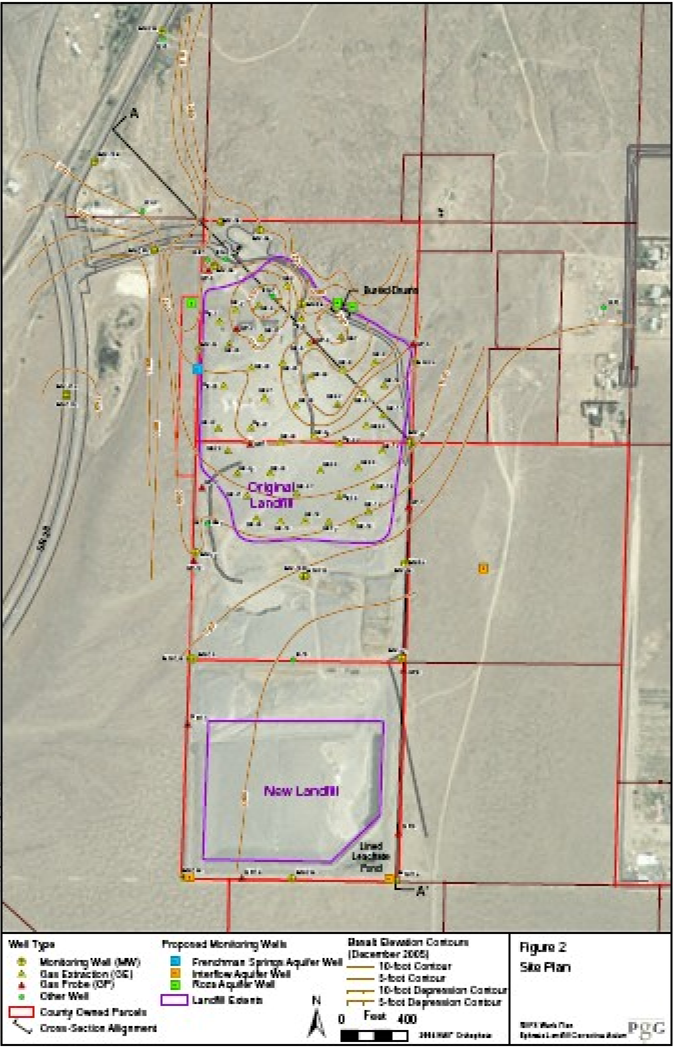
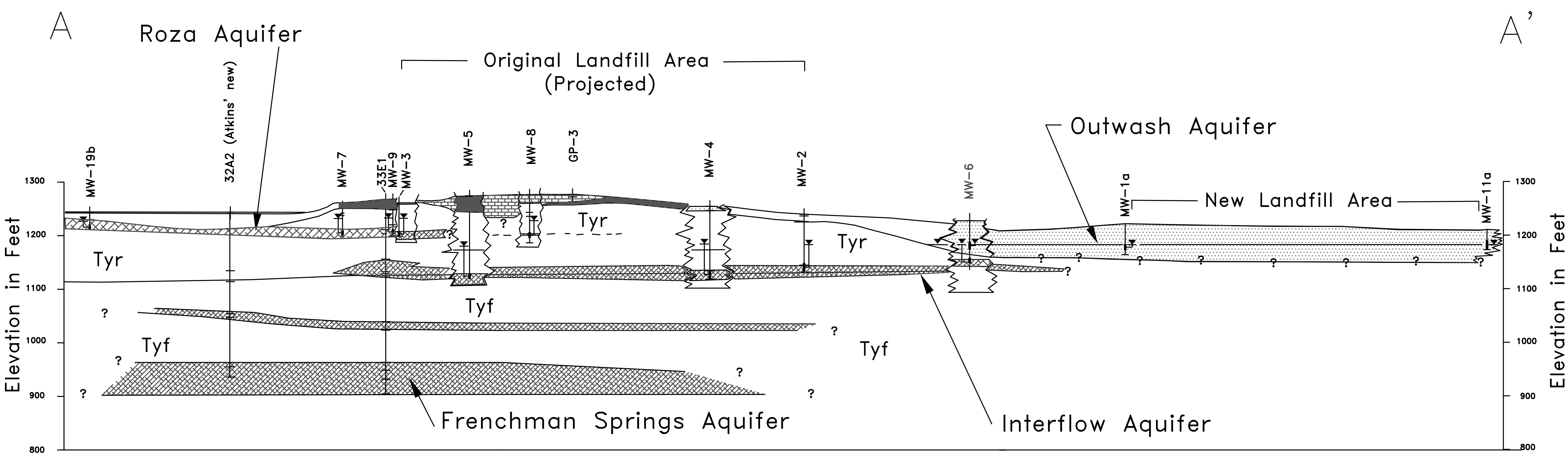


Figure 2
Site Plan

PGC



Legend

Outwash Gravel and Sand

Basalt Aquifers

Original Landfill Refuse

Tyf Basalt – Frenchman Springs Member

Tyr Basalt – Roza Member

Well Projected onto Section

Water Level in Well

0 100 200 400 800

Horizontal Scale in Feet
Vertical Exaggeration 2X

FIGURE 3

CROSS SECTION A–A'

RI/FS Work Plan
Ephrata Landfill Corrective Action

PGG

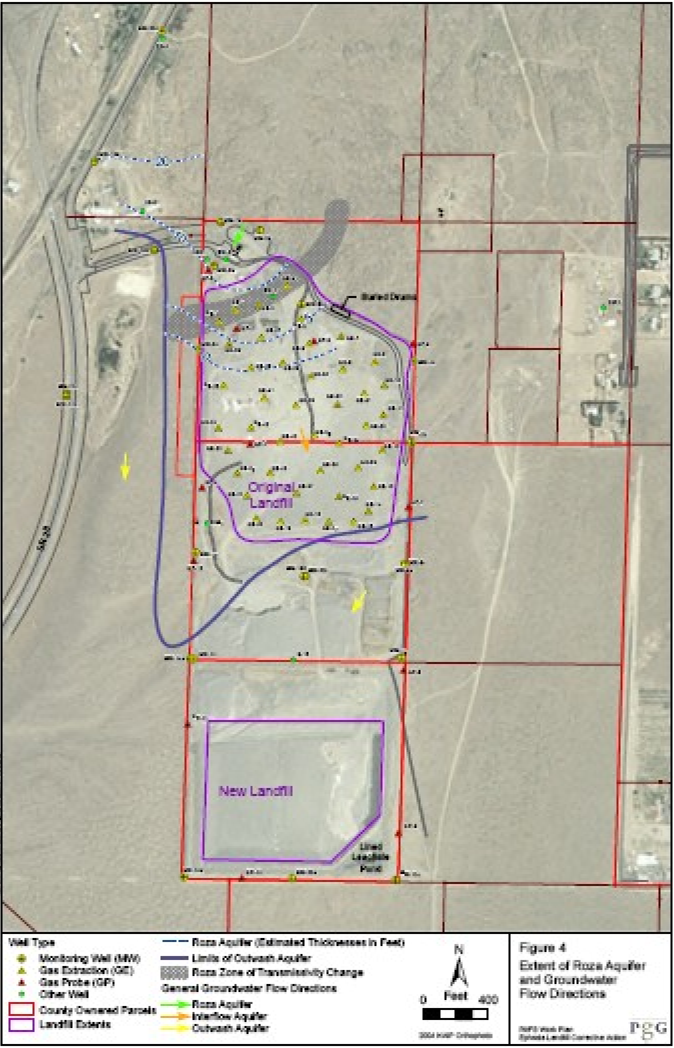


Figure 4
Extent of Roza Aquifer and Groundwater Flow Directions

PGG